Conference on Algorithmic Law Design and Implementation

APRIL 28-29, 2022

UNIVERSITAT DE BARCELONA

BOOKLET OF ABSTRACTS

https://www.ub.edu/prooftheory/event/lawdesign/

Algorithmic Law Design and Implementation

Booklet of Abstracts & Bios

Schedule

Thursday, 28th April 2022. Location: Aula Magna.

9:45	*Opening Session*: Begoña Román Maestre Pompeu Casanovas	Institutional opening by Dr. Román as Vice-dean of Research of the Faculty of Philosophy; and formal opening by Dr. Casanovas.
10:00	Joost J. Joosten	Algorithmic Law Design and Implementation. From Grave to Cradle
10:15	Mireia González Bedmar	Public Certification of Software and its necessity in Computable Laws. FV Time as the first application
11:00	Coffee break	
11:30	Yannick Forster	Verified extraction to OCaml from Coq, in Coq
12:15	David Fernández Duque	Logical Methods for Algorithmic Law
13:00	Lunch break	
15:00	Marlies van Eck	Auditing IT-systems used for automated individual decision-making in public sector; experiment in The Netherlands
15:45	Fernando Nubla Durango Monica Palmirani Willy van Puymbroeck	Drafting EU Legislation in the Era of AI and Digitisation
16:30	Break	
16:45	*Keynote*: Grant Olney Passmore	Formal Verification and Governance of Financial Algorithms with Imandra

Friday, 29th April 2022. Location: Aula Magna — Room 222.

9:30	Julius Lyk-Jensen Christine Holmgreen Mejling Mette Eigaard Rasmussen	Crafting a legislation ready for digital public administration
10:15	Moritz Müller	Model-Checking as an approach to algorithmic law and the case of Regulation 561
11:00	Denis Merigoux	Verifying well-behaved execution of legislative programs with the Catala domain-specific language
11:45	Coffee break	*Change to Room 222*
12:15	Liane Huttner	Is coding the law legal? A French and European approach
13:00	Lunch break	
15:00	Susana de la Sierra	Imagine lawyers are not your enemies: legal challenges and digital rights
15:45	*Keynote*: Bart Verheij	Hybrid intelligence for algorithmic law design
16:30	Break	
16:45	*Closing*: Juli Ponce Solé Agustí Cerrillo Martínez	

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1 Forward to the *Conference on Algorithmic Law Design and Implementation*

Echoes from the Grave

Dear reader,

This booklet of abstracts testifies of what I think is a very exciting experiment: a highly interdisciplinary conference on Algorithmic Law, its Design, and its Implementations. With *Algorithmic Law*, we mean any regulatory text that stipulates how a computer program should work. Our running example is[1] Regulation 561/2006 of the European Parliament and Council of the European Union. Most notably, European truck drivers can read in this Regulation how long they are allowed to drive in a row and how long and frequent they must rest.

Each truck driver is required to have a tachograph aboard that logs the driver's activity. So necessarily, Regulation 561/2006 implies instructions to a computer programmer that will need to interpret and process the digital driver's files. Behold, here is a seed of a main theme of our conference: how can a regulation, written in natural language unambiguously stipulate how the programmer should proceed? It is my conviction that with the current paradigm of Algorithmic Law the answer is simply: the programmer cannot take the regulation at face-value and proceed to programming without making essential decisions her or himself.

Other important questions readily prompt themselves: OK, suppose we have a decent program implementing R. 561/2006, how can we be sure that there are no *errors* in this program? It is a matter of fact and experience that *any* conventional computer program of substantial size will contain errors: either by design, by methodology or simply because the programmer wrote a typo. We have seen how such errors have caused crashing of helicopters, planes, and rockets which by itself is already bad and alarming. However, such errors in legal software moreover suppose a potential violation of citizen's rights: how can they be sure that the fine or imprisonment they receive is righteously imposed and not due to a programming error? How can they possibly rebut any verdict of the form *Computer says jail*?

Our project *Zero-error software*[2] partially answers this question: critical software in

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[1] European Parliament and Council of the European Union. Regulation (EC) no 561/2006 of the European Parliament and of the Council of 15 march 2006 on the harmonisation of certain social legislation relating to road transport. Official Journal of the European Union, 2006.

general and binding legal software in particular should mathematically be proven to be error-free. Moreover, we have been developing techniques to facilitate this. *Error free* refers here to there not being a single error in the computer program with respect to the *formal specification* of the computer program. This formal specification is written in a language of mathematical nature, otherwise, mathematical proofs would have been impossible.

This project as such is a huge step forward in the correct development of legal software. But difficult questions rarely have easy and simple answers. The proposed solution to eradicate errors begs tons of old and new questions in the new setting: How can we be sure that the formal specification of the computer program faithfully reflects the letter of the (natural language written) law? And for that matter, how can we be sure that the letter of the law fully reflects the spirit of the law and our moral intuitions? Could the formal specification simply *be* the law? Does the proposed solution not simply make it even harder for citizens to contest automated legal decisions? Can we make sure that different sorts of languages (formal, technical, natural, etc.) can be faithfully bridged somehow? Can we be sure that the specification does not somehow embodies a bias of the author of the specification? Or even worse, can we be sure that no nudging is entailed by the procedure?

Here, our experiment begins. We became more and more convinced that possible answers to these questions require essential contributions of various fields and disciplines: computer science, law, logic, linguistics, philosophy, political science, mathematics, etc. The experiment consists of just putting these disciplines together in one single conference. And here we ask the sheerly impossible of the speakers: to deliver a talk that is understandable to people outside your field yet informative for the colleagues in your field. This is a tremendous challenge and I look forward to seeing the result.

In our industrial project on zero-error software, I think that we spent at least one year levelling, and confiding in one another. For example, it took us, academics much time to understand that different traditions use different language. Very good ideas can be hidden in non-academic business language that lacks the usual academic rigorous exposition and argumentation. On the business side, it took time and confidence to see that academic esoteric ideas that are not directly presented including a production line can nonetheless be very relevant for production and marketing. These are just

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some examples of our levelling. And it took us over a year to grow to each other. At times it has been a tough ride, but hanging in there (for those who managed to hang in) made the trip very rewarding.

As I said, growing these two different cultures together took us more than a year and at times I feel we still have quite the way to go. Then, is it realistic to expect that within one conference the different disciplines are going to find a common ground, a common language, a common program? Not only do we have the above-mentioned different disciplines represented in our conference but we also have different working areas to deal with. There will be practicing lawyers, computer scientists, workers from public administrations, law professors, entrepreneurial scientists, industrial CEOs, mathematicians, philosophers, etc. Each and all of us with our cultural dispositions, our way of speech, etc. Indeed, it will be a hard time trying to find each other. I am not sure that we will do so in this first meeting. However, I am sure that I will be having a great time trying to find a common ground, and I hope that you, dear reader, will do so too. Enjoy the conference!

Joost J. Joosten,
Barcelona, April 18, 2022.

2 Abstracts

2.1 Marlies van Eck: Auditing IT-systems used for automated individual decision-making in public sector; experiment in The Netherlands

Date of talk: April 28, 2022

Abstract

If you want to know how the law works in practice; study the code instead of the law!

Though the government has used software to automate individual decision making since the '70 ies, only this century society seem to care what happens in the databases and networks of large bureaucracies. For long, the systems were treated as natural phenomena like the rain or the sea; it exists, has its own logic and individual humans have to learn how to deal with it. This has changed over the years. One may even say that the 'Millennium bug' (Year 2000 problem) was the first confrontation for citizens with the existence of systems that were made by humans and therefore not flawless.

It's very difficult to examine how highly automated public administrations have interpreted the laws they have to execute. This can be problematic since legislation often is ambiguous or vague because it is the result of a compromise in parliament. To translate this into code, many decision rules will be necessary. In this process, numerous choices that used to belong to people who interact with citizens face to face, the street-level bureaucrats, are transferred to system-level bureaucrats.

If documentation is used or written by system-level bureaucrats it's not automatically readable nor understandable by lay (wo)men, such as lawyers. This is worrying because more than the law itself, the IT systems determine how the law works in daily lives of citizens. For anyone who wants to know how the law works, studying the law alone is not enough. Back in the days, you could ask for complementary documentation like policy rules, internal instructions, handbooks and so on. These days more than before, the way the IT systems are instructed is the most relevant factor and exactly this is unknown.

This leads to the conclusion that public administration has gained the power of a legislator but without the checks and balances necessary in the Rule of Law. Legal protection for citizens has diminished. Where citizens, their representatives and judges had the right and competence to read and check all the internal formal policy rules or handbooks, this is not the case when the execution used IT -systems to replace human civil servants. This lead to the inconvenient conclusion that we have less knowledge on how the law works than before.

Eh ..but. . . how?

A few years and a major scandal later, the supervision of algorithmic systems of the governments in the Netherland is high on the agenda. But little is known on how to perform such research and what answers investigators are looking for in order to determine if the agency produces lawful individual decisions and designed the system and execution according to key administrative law principles. A legal investigator follows another research method then an IT specialist. It is important the involved different disciplines understand each other's language, research methods and frame works in order to develop a more holistic view. The benefit of a co-creative approach can as well mean that public administrations are not delved under audit after audit.

The Dutch experiment

In February 2022 Marlies van Eck starts a project to seek the answer to the 'how' question. Along with the cooperation of experts working for the government, the Ministry of Interior and Kingdom Relations and National ombudsman the researchers are developing a working method to examine IT systems from three different angles:

- Quality of rules and design of the system seen from peer system level bureaucrats.
- Lawful implementation and compliance with the administrative law principles / right to good administration observed by legal scholars.
- Risks on unlawful execution of legislation (and spending public funds) in relation to accountability obligations studied by (IT) auditors.

The first public administration opening the door and giving access to their experts for this research is the School and Studies Funding Organisation (DUO). Part of the research method is that during the process the group will share results publicly in order to involve the public and use wisdom of the crowd.

The project ends in June 2022. This means that all results are welcomed and a step to enhance mutual understanding and hopefully the beginning of a new approach.

In the conference, Marlies van Eck presents the preliminary findings. Also she is very curious to hear your ideas and insights.

2.2 David Fernández-Duque: Logical Methods for Algorithmic Law

Date of talk: April 28, 2022

Abstract

As technology becomes more and more intertwined with everyday life, the need arises to legislate activities which are primarily recorded on digital media. Enforcement of such legislation often requires the aid of AI, which raises a dilemma: is artificial intelligence suitable for imposing fines or even jail time to humans? One solution is to develop explainable AI, where any decision comes with a human-readable justification of correctness. We will argue that this could be achieved with the help of computational logic, then discuss the intricacies of representing legislation within a logical framework amenable to automated treatment.

2.3 Yannick Forster: Verified extraction to OCaml from Coq, in Coq

Date of talk: April 29, 2022

Abstract

This talk will present joint work with Matthieu Sozeau, Pierre Giraud, Pierre-Marie Pedrot, and Nicolas Tabareau from the Gallinette team in Nantes at Inria Bretagne Atlantique Rennes[3]. We are working on verifying the extraction process from programs implemented in the Coq proof assistant (a

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so-called interactive theorem prover) to executables usable from OCaml programs, where the verification process is also being done in Coq, based on the MetaCoq project.

An interactive theorem prover is a computer program which can be used to develop and check mathematical proofs. Proofs checkable by interactive theorem provers are written in a kind of programming language, where the user has to break down details down to a basic logical level, but also gets assisted by the interactive theorem prover which is able to fill in certain steps automatically. Interactive theorem provers are complex programs, but overall much less complex than software commonly used on computers or than proofs found in mathematics. Thus, interactive theorem provers can be used to obtain the highest possible confidence in proofs: One just has to make sure that the interactive theorem prover is correct, from then on it can be used to verify the correctness of arbitrary proofs.

The Coq proof assistant is an interactive theorem prover developed initially by Inria (Institut national de recherche en informatique et en automatique) in the 1980s in Paris Roquencourt, and is now developed by a multi-national team of contributors. It has won a number of awards, most recently the French Open Science Award for Open Source Research Software.

Computer programs can be verified in the Coq proof assistant as well, because ultimately their correctness can be broken down into logic. Thus, Coq can also be used to obtain the highest possible confidence into computer programs. Verifying a program creates a big overhead: writing proofs in the proof language of Coq takes - to no surprise - a lot longer than just informally arguing a proof. In general, there are two ways to verify computer programs using Coq: (1) model the whole programming language you want to use mathematically. This works, but for most modern programming languages it is a years-long project to correctly describe the programming language, because programming languages are complicated and often not perfectly well-defined. (2) write the program directly in Coq, then use "extraction".

Extraction automatically transforms a program written in Coq to an industrial programming language like OCaml or C. To trust that the extracted programs are correct, one has to trust Coq and to trust the extraction process, but nothing else. One can again use verification in Coq to gain the highest possible level of confidence.

MetaCoq is a research project on implementing and verifying the implementation of Coq in Coq itself. As part of MetaCoq, we are also working on verifying the extraction process: As a result, we will have the highest possible confidence that every program written in Coq and then extracted to OCaml will compute exactly as specified.

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2.4 Mireia González Bedmar: Public Certification of Software and its necessity in Computable Laws. FV Time as the first application

Date of talk: April 28, 2022

Abstract

Our work in the transportation law field has given us perspective on the kind of problems that need to be solved to develop 100%-reliable software for Law applications. Formal verification is the main technical methodology, yet it is not enough by itself in this field, since the behavior of the software must be not just properly specified, but also accessible and understandable for enforcement agencies and citizens. In this talk we present what formal verification can (and cannot) achieve, and address the issue of accessibility via our own defined protocol, Public Certification of Software, going beyond mere formal verification. We also present a small-scale project which has gone through Public Certification: FV Time, a library for managing conversions between time formats (UTC and timestamps), as well as commonly used functions for time arithmetic.

2.5 Liane Huttner: Is coding the law legal? A French and European approach

Date of talk: April 29, 2022

Abstract

Governments and private companies around the world use algorithms to calculate taxes, social benefits, and unemployment benefits. This means that individual decisions with serious consequences are taken based on laws written in code. This raises several issues. Is the correspondence between the law

and these codes always guaranteed? What are the legal consequences of bugs? Does law as code contradict certain general legal principles? Must important decisions be taken by human beings? In this talk, I will show how European and French law have attempted to answer these questions, principally by creating a framework for algorithms that code the law. In particular, I will focus on two requirements set by European and French law: necessity and transparency.

2.6 Joost J. Joosten: Algorithmic Law Design and Implementation. From Grave to Cradle

Date of talk: April 28, 2022

Abstract

With this talk we will open the conference. The conference was at first conceived as a closing of our RETOS project Zero-error Software.

In the talk we shall give a brief overview of the activities that we developed in the project, including logico-mathematical analysis of quantitative temporal regulations, implementing error-free disambiguations of those regulations, and model checking for road transportation among others. Next we discuss how the end of this project naturally leads to various follow-up activities and projects, most notable our current project PERSEIADER on the intersection of Logic, Artificial Intelligence and Administrative Law.

2.7 Christine Holmgreen Mejling, Mette Eigaard Rasmussen & Julius Lyk-Jensen: Crafting a legislation ready for digital public administration

Date of talk: April 29, 2022

Abstract

The Danish Agency of Digitisation will present the initiative of digital-ready legislation. Since 2018, all legislative drafts has undergone a digital check emphasizing simple and digitally compatible legal rules, debureaucratization and a high level of digital transparency for citizens. One of the central aims of the program is to promote automated digital case processing of legal rules.

In this presentation, we will introduce the specific methods and principles for creating digital-ready legislation in the context of Danish public administration alongside with a number of concrete cases. Throughout the presentation, we will address questions like:

- What are main attention points when digitalizing legislation?

- What criteria does legal texts has to fulfil in order to support automated processing?

- What are the scope for the future of automation and AI use in Danish public administration, and how can we make legislation fit for this development?

2.8 Denis Merigoux: Verifying well-behaved execution of legislative programs with the Catala domain-specific language

Date of talk: April 28, 2022

Abstract

Legal statutes can contain descriptions of algorithmic decision processes. In that regard, certain domains of the law are thus more "algorithmic" than others. For instance, tax law is about the computation of the amount of taxes owed by an individual, depending on her income and family situation. More interestingly, these legally-defined algorithms are usually enforced by computer programs called legal expert systems, that government agencies or large organizations have been using for decades. Merigoux et al. [2021] cast light on the issues related to the maintenance and production of these legal expert systems, and their faithfulness to their corresponding legislative specification. To tackle those issues, a novel domain-specific language, Catala, was described and formalized in the same paper. By design, Catala programs closely follow the logical structure of legal statutes. Thus, Catala enables a pair programming and literate programming methodology that raises the level of assurance of legal expert systems, while providing a usable toolchain amenable for production deployments.

In this presentation, we present work in progress on a new system to expand the Catala toolchain into a proof platform for verifying low-level and high-level properties about Catala programs. In particular, the we show that it is possible to translate a notion of correct legislative drafting into a formal property of well-behaved execution for the Catala programs corresponding to the law. Building on this example, we show that legislative drafting and automatic enforcement can benefit from formal verification.

2.9   Moritz Müler: Model-Checking as an approach to algorithmic law and the case of Regulation 561

Date of talk: April 29, 2022

Abstract

Algorithmic law spans a wide variety of topics. We focus on the algorithmic application of a law to a case as a computational problem, namely a model-checking problem for a logic formalizing the law and a suitable class of structures representing cases. The central constraint is the computational complexity of this problem. The talk discusses the quest for a general purpose model-checking problem that faithfully and feasibly models applications of the transport Regulation 561 to tachograph recordings of truck drivers.

2.10   Grant Olney Passmore: Formal Verification and Governance of Financial Algorithms with Imandra

Date of talk: April 28, 2022

Abstract

Many deep issues plaguing today's financial markets are symptoms of a fundamental problem: The complexity of algorithms underlying modern finance has significantly outpaced the power of traditional tools used to design and regulate them. At Imandra, we have pioneered the application of formal verification to financial markets, where firms like Goldman Sachs, Itiviti and OneChronos already rely upon Imandra's algorithm governance tools for the design, regulation and calibration of many of their most complex algorithms. With a focus on financial infrastructure (e.g., the matching logics of national exchanges and dark pools), we shall describe the landscape, and illustrate our Imandra algorithm governance system on a number of real-world examples. We'll sketch many open problems and future directions along the way.

2.11 Willy van Puymbroeck, Fernando Nubla Durango & Monica Palmirani: Drafting EU Legislation in the Era of AI and Digitisation

Date of talk: April 28, 2022

Abstract

The presentation will sketch the context of law making/the development of policies in the EU and the imperative for its digital transformation. It is posited that we are at the verge of a paradigm shift brought about by machine-processable-law and the availability of novel IT. This will change the way law and policy are developed and significantly improve quality, boost efficiencies and perhaps most important increase transparency bringing law closer to the citizen and improve its effectiveness.

The focus in the presentation will be on legal drafting in the European Commission (EC), though a broader perspective addressing EU Institutions and Member States will be presented.

Three topics will be elaborated in detail (i) A Platform for Law-Making with a plea for more interdisciplinary research and the application of Hybrid AI with Human Oversight, (ii) An IT eco-system with Augmented LEOS at its core. LEOS is the open-source drafting tool currently being rolled out in the EU. Promising avenues along which LEOS could be further developed will be highlighted, and (iii) a Comprehensive Roadmap for the emerging 'LegalTech' domain, soliciting the contribution of the Conference participants.

Conclusions will centre on 'Qubits for Law'.

2.12 Susana de la Sierra: Imagine lawyers are not your enemies: legal challenges and digital rights

Date of talk: April 29, 2022

Abstract

Law is in many occasions not regarded with friendliness, in particular because of its obtuse language but also due to its connotations with conflict. Yet it is the instrument societies have developed precisely to prevent conflict, to address it or simply to organize institutions, human resources and budgets in order to know beforehand what is to be expected and how is action to be conducted. Law should therefore be regarded as an ally and not as an enemy, also in the digital era. Nevertheless, its role needs to be better explained.

Law is a cultural product and, therefore, it is context-dependent. Also, the legal language is a particular one, but it needs to enter into a dialogue with other languages, namely the languages of the areas which are going to be covered by the norms in a specific case. For instance, a norm allowing the adoption of measures to face a pandemic has to take into consideration expertise on epidemiology and other scientific fields. Ideally, experts and lawyers should work hand in hand to promote legal changes and to supervise legal enforcement.

Disruptive technologies challenge societies and thus challenge also their laws. The relationship between these technologies and the laws is, at least, twofold. On the one hand, the law anticipates risks associated with these technologies and creates spheres of protection (digital rights, mainly) to face those risks. On the other hand, from a more positive perspective, disruptive technologies are an opportunity for the law to be better created and applied. "Better" should be here understood as a notion linked to efficiency and accuracy (caveat: not necessarily to justice). Some examples can be provided here: 1) the use of AI to gather information so as to gain knowledge that improves the quality of legislation and enforcement; 2) its use to produce automated legal decisions or 3) to engage in conversations with others and provide the (legal) information required.

In the presentation it will be argued that a dialogue between lawyers and other experts (engineers, computer scientists, among others) is required to better produce the law and apply it in the digital society. The obtuseness of law will be addressed in this framework, explaining the reason for it but

also pointing at ways out towards a better understanding for non-lawyers. If cooperation is required, and if the positive effects of disruptive technologies on the law are undeniable, some difficulties concerning the "full mathematization" of the law will also be put forward, departing mainly from the cultural nature of both law and language. In this context, the need to protect digital rights arises again.

2.13 Bart Verheij: Hybrid intelligence for algorithmic law design

Date of talk: April 28, 2022

Abstract

Artificial intelligence has become a powerful, ubiquitous set of technologies, and has been applied in the field of law for many decades. By the nature of the law, various kinds of AI are relevant (in particular knowledge representation and reasoning, machine learning and natural language processing), and their combination leads to fundamental questions of high societal relevance. In this talk, the requirements of explainabilty, responsibility and societal alignment are used as the background for a discussion of what is now possible using contemporary AI algorithms—and what is not. It is argued that AI can learn much from lawyers. Since lawyers combine logical reasoning with example-based analogy in a critical discussion, new hybrid AI methods are being developed innovating the field.

3 Biographies

3.1 Marlies van Eck

Marlies van Eck is an administrative lawyer with a back ground in both administrative law and IT law. When she worked as a lawyer representing a highly automated public administration in administrative courts and unable to understand some of reasons behind the logic of the computers, she started her research on the consequences of automated chain decisions on the legal protection of citizens.[4]

Marlies still combines practice and theory. She is partner at a small consultancy firm Hooghiemstra & Partners in The Hague and assistant professor at Radboud University Nijmegen and one of the experts in the Dutch National AI course, free for all citizens and based on Elements of AI. In 2021 she was awarded with the Hermesdorf Talent by the board of Radboud University ('to researchers who have shown a certain degree of courage, stuck their necks out or not flinched in the face of opposition'). More information on her research? Watch this public lecture (with English subtitles) `https://youtu.be/tgYSRUzICio` by University of The Netherlands.

3.2 David Fernández-Duque

David Fernández-Duque obtained his PhD from Stanford University in 2008, under the supervision of Grigori Mints. His thesis, "Results on Dynamic Topological Logic", included ground-breaking results which earned him the prestigious Kurt Gödel Centenary Research Prize. As a postdoctoral researcher in the University of Seville, he became involved in unconditionally secure communication and Provability Logic, the latter commencing a central theme of his research in the application of topological methods to proof theory. After a few years in his native Mexico, he became CIMI Research Fellow at IRIT, Toulouse, where he aimed his work on spatio-temporal reasoning towards potential applications in robotics and AI. He is now a researcher at Ghent University, working on connections between proof theory and computable functions with Andreas Weiermann. His most recent work involves applications of

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[4]English summary from page 439: van Eck, M. (2018). Geautomatiseerde ketenbesluiten & rechtsbescherming: Een onderzoek naar de praktijk van geautomatiseerde ketenbesluiten over een financieel belang in relatie tot rechtsbescherming. `https://pure.uvt.nl/ws/portalfiles/portal/20399771/Van_Eck_Geautomatiseerde_ketenbesluiten.pdf` or: `https://www.universiteitleiden.nl/binaries/content/assets/rechtsgeleerdheid/instituut-voor-metajuridica/elaw-working-paper-series/wps2018.006.marllieseck.thesisenglishsummary.pdf` (universiteitleiden.nl)

temporal reasoning to law, with the aim of producing verified software to automatically establish the legality of transport activity with European regulation. He is currently leading two international research projects with TU Wien and the University of Bern, respectively, centered around themes involving proof theory and spatio-temporal reasoning.

Within the Secretariat for digital-ready legislation Mette works with consultation responses for draft legislation, self-assessment tools for compliance with the principles for digital-ready legislation and developing guides on the subject.

Her interests include the logical aspect of programming (she can't code) and automating the legislative process.

3.3 Yannick Forster

Yannick Forster is a postdoctoral Marie Skłodowska-Curie fellow at Inria in the Gallinette team in Nantes. He studied in Saarbrücken, Germany, and Cambridge, UK, and did his PhD at Saarland University under the supervision of Gert Smolka. His research centers around analysing, formalising, and machine-checking different aspects of computation in constructive type theory, and especially in the proof assistant Coq. He is a maintainer of the Coq Library of Undecidability Proofs and a member of the MetaCoq and CertiCoq teams. Currently, he is working on verifying the extraction process from Coq to OCaml based on the MetaCoq project.

3.4 Mireia González Bedmar

Mireia González Bedmar is a developer and researcher in Formal Vindications S.L., in the field of formal verification of software. After getting a Bachelor's degree in Mathematics and a Master's degree in Logic, her work since 2018 focuses on developing verified software for the legal sector, as well as the more ambitious goal of creating a general methodology to make verified software accessible for wider audiences. The main tools for her work are the Coq proof assistant together with the MathComp library.

3.5 Liane Huttner

Liane Huttner is a PhD candidate at Paris 1 Panthéon-Sorbonne, under the supervision of Professor Judith Rochfeld. Her research focuses on data protection and algorithm law. Her thesis will provide a conceptual frame for the interpretation and application of article 22 of the GDPR. In addition, she works on the Catala project,

an interdisciplinary project which aims to create a computer language adapted to the law.

Her work has appeared in the Repertoire Dalloz, the Sorbonne Law Review and the Revue de droit fiscal. In 2019, she was a visiting fellow at the Institute of European and Comparative Law of the University of Oxford and at the Maison française d'Oxford. In 2021, she was part of the Institute Scholarship Program at the Max Planck Institute for Comparative and International Private Law in Hamburg. She has taught many courses in Private Law such as Contract Law and Tort Law. Since 2020, she teaches a master's class at University Paris 1 on Law and new technologies.

3.6   Joost J. Joosten

Joost J. Joosten studied mathematics and physics at the University of Amsterdam, after which he did a master in Logic at the Institute for Logic, Language and Computation and worked one year as maths teacher at an International Baccalaureate School. He did his PhD at the Philosophy Faculty of the University of Utrecht. After various Post-Doc positions around Europe and some years at Risk Management at an international trading bank, Joosten started working at the University of Barcelona since 2010. His more theoretical interests focus on foundations of mathematics and on formal logic and more recently Joosten also embarked on applied proof theory in problems related to errors in software in general and in quantitative temporal legal software in particular. Over the past five years Joosten has led five different projects on this topic with a total investment of over two-and-a-half million euro. The current conference was originally envisioned as a closing of the larger of these projects but now coincides with the start of a new and much related project. Logic and Law have much to offer to each other.

3.7   Julius Lyk-Jensen

Works in the Secretariat for digital-ready legislation at the Agency for Digitisation. He has a master in political sociology from Copenhagen Business School. Julius' primary interest is in the meeting between digitalisation and human behaviour.

3.8   Christine Holmgreen Mejling

Works in the Secretariat for digital-ready legislation at the Agency for Digitisation. She has a master's degree in political science, University of Copenhagen.

3.9 Denis Merigoux

Denis Merigoux is a recently graduated PhD at Inria inside the Prosecco team, where he was under the supervision of Karthikeyan Bhargavan and Jonathan Protzenko, and specialized in the study of programming languages and formal verification. After applied his novel philosophy of proof-oriented domain-specific programming languages to the domain of cryptographic implementations, Denis turned to the difficult problem of turning law into code. The focus of Denis' research is towards real-world applications, and he has been collaborating with the French tax administration to modernize their income tax computation infrastructure. Denis started in January 2022 a Starting Research Position at Inria to continue his work at the intersection of law and computer science, around the new domain-specific language Catala.

3.10 Moritz Müller

I work in mathematical and philosophical logic, specifically its intersection with theoretical computer science. I obtained a PhD in mathematics in 2009 at the university of Freiburg under the supervision of Jörg Flum. I spent most part of my postdoctoral career under Sy David Friedman, first as a postdoc at the Centre de Recerca Matemàtica (near Barcelona) and mainly at the Kurt Gödel Research Center, a research platform at the university of Vienna, namely as postdoc, as lecturer, as PI and as deputy director. In 2018 I returned to Barcelona to work as a postdoc under Albert Atserias (UPC) and since 2021 first at Formal Vindications and currently at the university of Barcelona (UB) under Joost J. Joosten. Coming winter term I start working as a full professor for mathematical logic at the university of Passau.

3.11 Fernando Nubla Durango

Fernando Nubla Durango is an IT Project Manager at European Commission. He finished studies at the University of Deusto (Bilbao, Spain) and received Master's degree on Informatics Engineering.

He has a solid background on software design and development of IT solutions. As a connoisseur of different Information and communications technologies, he conscientiously and professionally transmits his knowledge and experience onto the younger generations.

Passionate about open source software, he has contributed to several solutions over the last decade. As from 2019, he is the leading force of the project LEOS (Legislation Editing Open Software) an open source solution that is designed to make

legislation drafting more efficient and to help those involved in this process by facilitating efficient online collaboration.

3.12 Monica Palmirani

Monica Palmirani has been full professor in Computer Science and Law and Legal Informatics at University of Bologna, School of Law. She co-chairs the LegalDocML and the LegalRuleML. Since 2013 she serves on the OASIS LegalXML Steering Committee. In 2015, she was recognized as an OASIS Distinguished Contributor. She was member of Board of Directors of OASIS from 2016 till 2018. Her research fields include XML techniques for modelling legal documents in structure as well as in aspects connected to legal knowledge, including logic rules and legal ontologies, and ICT-enhanced legal drafting techniques using artificial intelligence techniques. She is also the scientific coordinator of the Legal Blockchain Lab. She has published more than 120 papers and she has been chair of several international conferences, editor of book series and member of the scientific committee of "AI and Law" Journal. She is Director of the International PhD programme "Law, Science and Technologies" MSCA-ITN, vice-president of IAAIL.

3.13 Grant Olney Passmore

Grant Passmore is co-founder and co-CEO of Imandra. Grant is a widely published researcher in formal verification and symbolic AI, and has more than ten years' industrial formal verification experience. He has been a key contributor to safety verification of algorithms at Cambridge, Carnegie Mellon, Edinburgh, Microsoft Research and SRI. He earned his PhD in AI for algorithm safety from the University of Edinburgh, is a graduate of UT Austin (BA in Mathematics) and the Mathematical Research Institute in the Netherlands (Master Class in Mathematical Logic), and is a Life Member of Clare Hall, University of Cambridge.

3.14 Willy van Puymbroeck

Willy van Puymbroeck obtained a PhD in Physics from the University of Antwerp in 1981. Before joining the European Commission in 1988 he worked as a Software Engineer in the telecommunication industry. His main activity then concerned programming languages and proof systems.
At the European Commission he held different position mainly working in DG CONNECT in various domains such as Integrated Manufacturing, Semiconductors and

eGovernment. In 2018 he moved to DG DIGIT to take the responsibility for 'IT Solutions for Legislation, Policy and HR'. Since 2020 he is an active senior in the Commission working on the LEOS – Legislation Editing Open Source – project.

3.15 Mette Eigaard Rasmussen

Mette Eigaard Rasmussen has a LL. M. from Aarhus University. Previously she has worked with drafting legislation and competition law.

3.16 Susana de la Sierra

Susana de la Sierra is Associate Professor of Administrative Law at the University of Castilla-La Mancha (Spain), LL.M in German and Comparative Law from the University of Bayreuth (Germany) and Ph.D. from the European University Institute in Florence (Italy). Her work has focused on comparative public law, administrative justice, law & culture and rights in the digital society. She has been visiting scholar in various Universities (Oxford, EUI, LUISS) and Fulbright Visiting Scholar at the University of Columbia in the special programme US-EU. Head of the Spanish team (2010 – 2012) in the European research project MEDIADEM (European Media Policies Revisited: Valuing and Reclaiming Free and Independent Media in Contemporary Democratic Systems), between 2012 and 2014 she acted as Director General of the Spanish Film Institute, where she promoted a new regulation for the audiovisual industry. Between 2016 and 2019 she served as law clerk to the Spanish Supreme Court and contributed to the first three years of the new administrative revision system ("casación"). She was one of the experts appointed to draft the Spanish Charter of Digital Rights (2020-2021) and is currently working on recent challenges of administrative justice, including the role of AI therein. Languages being one of her passions – she speaks six -, she enjoys also reflecting on and discussing their role in law.

3.17 Bart Verheij

Bart Verheij (https://www.ai.rug.nl/~verheij/) has a background in mathematics and has studied AI & Law since the 1990s. He holds the chair of artificial intelligence and argumentation as associate professor at the University of Groningen. He is head of the department of Artificial Intelligence in the Bernoulli Institute of Mathematics, Computer Science and Artificial Intelligence, Faculty of Science and Engineering. He is co-coordinator of the 'Responsible Hybrid Intelligence' line in

the Hybrid Intelligence project (`https://www.hybrid-intelligence-centre.nl/`). He was president of the International Association for Artificial Intelligence and Law (IAAIL) and is vice-president/secretary of the Foundation for Legal Knowledge Systems (JURIX).

4 Afterword to the booklet of abstracts of the *Conference on Algorithmic Law Design and Implementation*

Chortles from the Cradle

The expression *from the cradle to the grave* was used by Winston Churchill in reference to the future existence of a complete system of social protection for British citizens promoted by the Beveridge study at the beginning of the forties of the last century at a difficult time in the midst of the Second World War. The final birth of a Welfare State was undoubtedly one of the most important events of the 20$^{\text{th}}$ century.

The beginning of the 21$^{\text{st}}$ century is certainly not being easy either. The various terrorist attacks in the world, including the one in Madrid in 2004, with almost two hundred dead and more than two thousand wounded, and the one in Barcelona in 2017, with 16 dead and 131 wounded, the Great Recession and the Covid-19 pandemic, among other serious events, are proof of these difficulties.

It is in this context that the called fourth industrial revolution is developing, with the growing use of algorithmic systems and artificial intelligence in both the private and public sectors. This revolution raises great hopes for the improvement of people's quality of life, just as the Welfare State did, and everything seems to point to the fact that algorithms will accompany us *from the cradle to the grave* too.

With a positive view of the world we are entering, the recent book *Noise*, written by Nobel laureate Kahneman with the collaboration of Sibony and the law professor Sunstein, makes a strong defense of algorithms as an instrument to avoid unwanted different decisions in similar contexts. However, it would be naive or self-serving to deny the risks also posed by the use of algorithmic systems, including possible programming errors, cognitive biases of programmers transferred to algorithms, as well as biases involved in the data handled and statistical biases. Risks that if they materialize can cause damage with a much greater amplitude, repetition and impact than in the case of decisions made by humans.

It is a major challenge to have robust and reliable algorithmic systems that are subject to the rule of law, that enhance and do not undermine the Welfare State (automating inequality, according to the tittle of the well-known Eubanks' book) and Democracy (by means of nudging creating manipulation, as the Council of Europe has already alerted). Those systems must help to make effective the right to good

administration of citizens in front of governments and the rights of consumers in relation to companies. Achieving this will require the collaboration of the public and private sectors and knowledge from various sciences, including law.

To contribute to this task, several European researchers from the fields of law, political science and mathematics promoted the research project *CITIZEN CENTRIC PUBLIC SERVICES, BIASES AND ARTIFICIAL INTELIGENCE: TOWARDS A CONSOLIDATIONS OF DIGITAL RIGHTS IN THE PUBLIC ADMINISTRATIONS*. The project was funded by the Spanish government and will be developed over the next three years. It is, therefore, a baby, which is taking its first steps and wants to learn from those already taken by other previous projects, such as the one explained by Professor Joosten. We can consider this new project a *reincarnation* of the one that is now disappearing with the celebration of this interdisciplinary conference, in which the new and the old, what is still in the cradle and what is walking towards the grave, come together to continue advancing.

The questions posed by Professor Joosten by means of the research project that is moving towards the grave are similar questions that the new baby project that is beginning to take its first steps will try to answer. In short, how to ensure that the translation into computer code of legal rules written in natural language is reliable and free of errors and biases? Who will do this translation? What kind of legal designs and technical guarantees are necessary? How can we have a better regulation using algorithmic systems?

I am sure that the ideas developed during the conference and briefly presented in this compilation will be of great help for future research and its applied development.

Therefore, we would like to thank the speakers for their participation, ideas and contributions to the advance of the knowledge in this area.

Juli Ponce Solé,
Barcelona, April 19, 2022.

5 Organization and collaborators

Program Committee	Organizing Committee
Joost J. Joosten	Joost J. Joosten (Co-Chair)
Julio Ponce Solé	Julio Ponce Solé (Co-Chair)
	Petia Guintchev (Secretary)
	Gabriel Andrés Molero
	Eric Sancho Adamson
	Isabel Serra Domènech
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